AN898
APPLICATION NOTE

EMC GENERAL INFORMATION

by Microcontroller Division Applications

INTRODUCTION

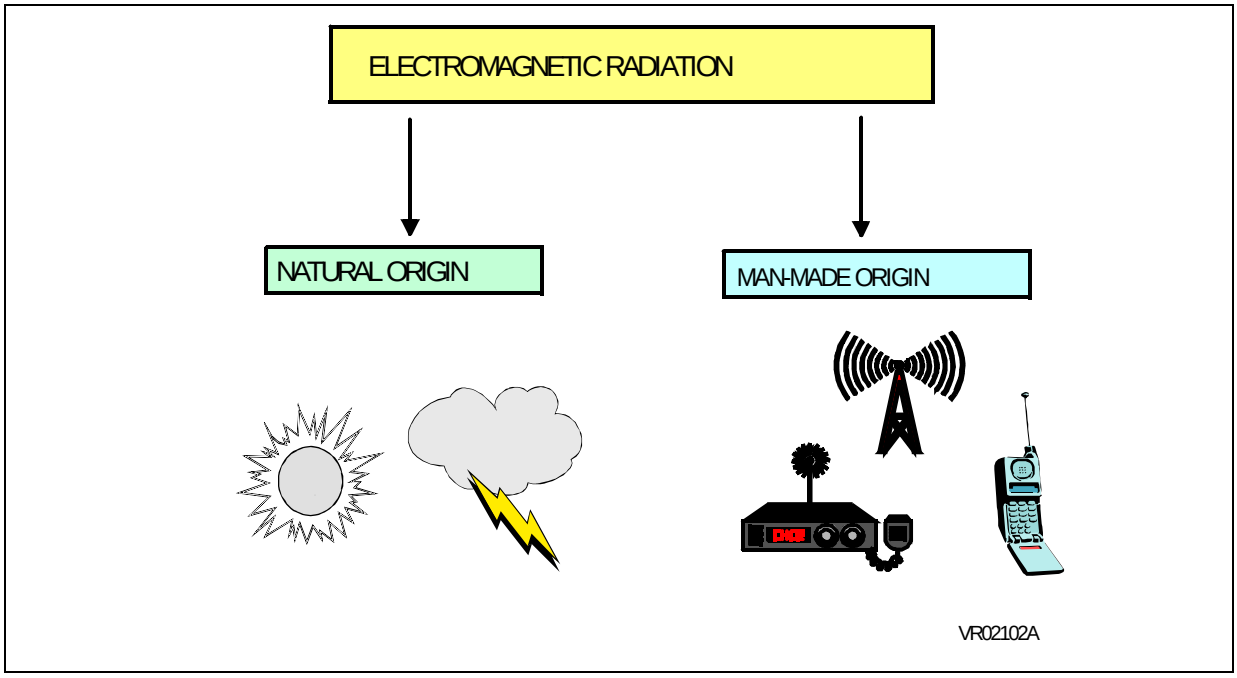
Because many electronic circuits are in proximity to each other, it is essential that their design is not affected by external noise sources and that the circuit itself is not a noise source affecting other circuits. This relationship is known as **electromagnetic compatibility** or **EMC**.

Sources of electromagnetic noise are numerous and have both **natural** and **man-made** origins.

Natural sources below 10 MHz are dominated by the atmospheric noise generated by electrical storms. Above 10 MHz, natural sources consist primarily of cosmic noise and solar radiation.

Man-made noise include AM, FM, TV and other broadcast transmitters, mobiles radios but also computing devices, motors, appliances, power lines, auto ignition systems and many others. With the proliferation of these sources (particularly in urban areas), electromagnetic noise has reached important levels.
For detailed information regarding EMC guidelines for microcontroller - based applications, please refer to AN901.

Figure 1. Electromagnetic Radiation Sources

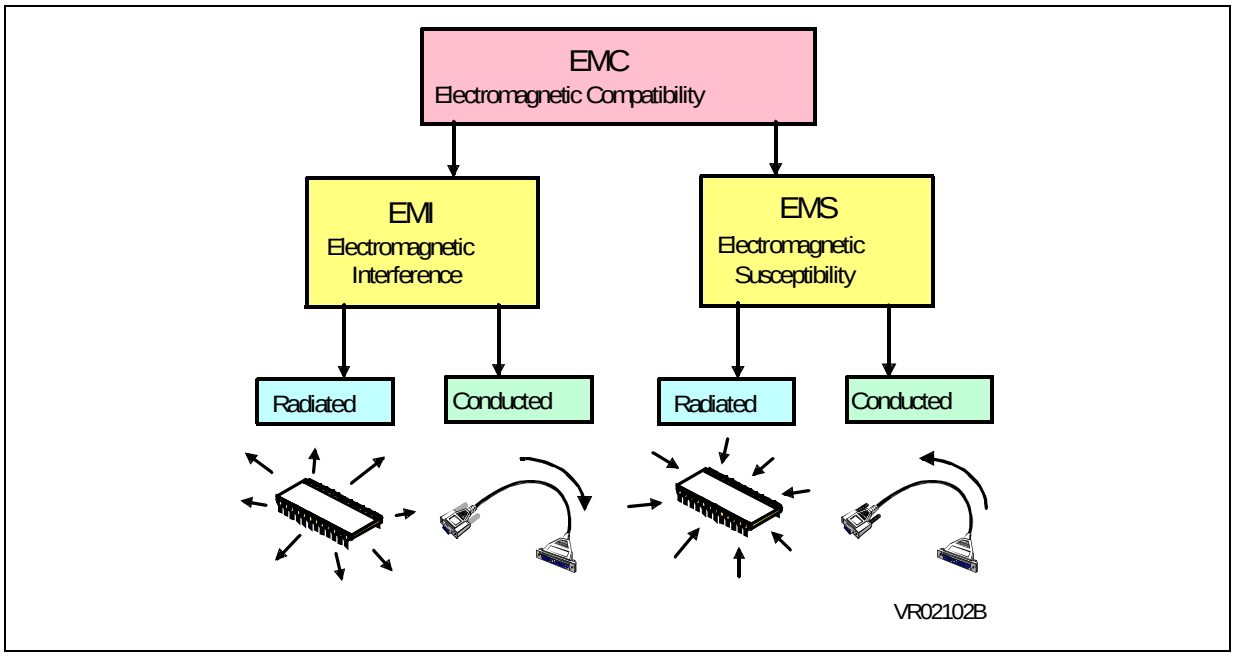


1 EMI AND EMS

Almost every electronic device emits some **electromagnetic interference (EMI)**. These emissions can be **transmitted** as electromagnetic radiation or **conducted** through cables such as power cords. At the same time, most electronic devices are susceptible to **emissions** generated either internally or by other devices.

Receptors susceptible to electromagnetic radiation include communication receivers such as radio and television, radar and navigation devices or computing devices. The effect of the interference on the receptor depends on several parameters: strength of the source, transmission medium, distance from the source, coupling mechanisms and degree of susceptibility of the medium.

Figure 2. EMC Contents: EMI and EMS



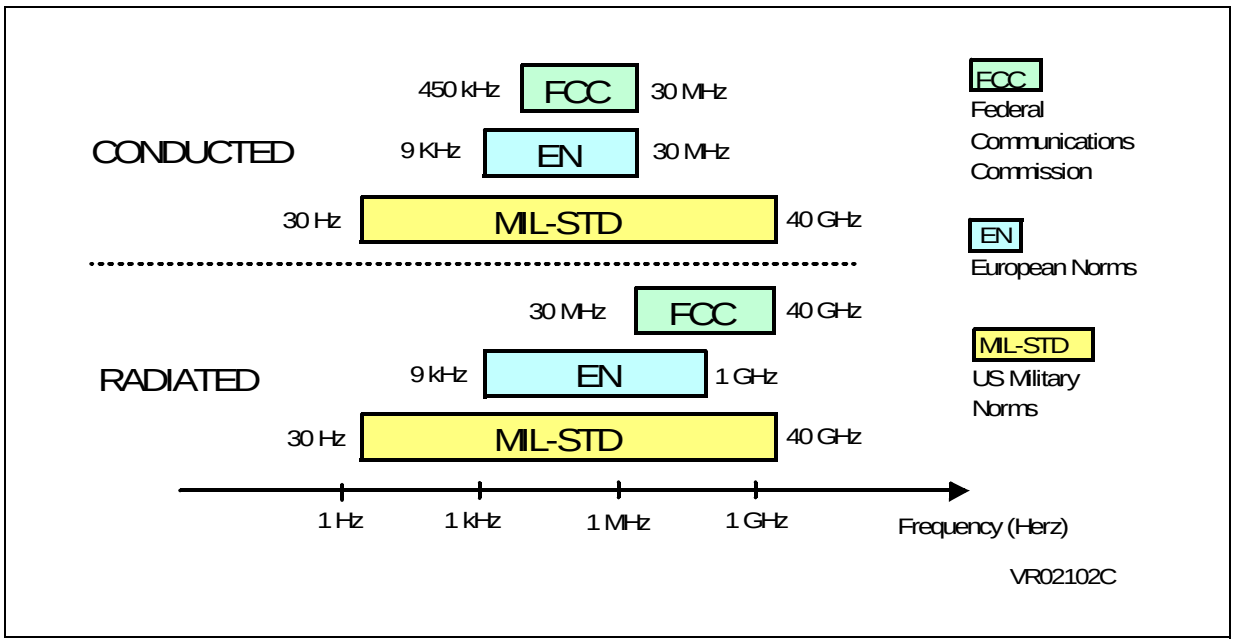
Electromagnetic interference (EMI) tests involve measuring the frequency and amplitude of undesirable signals emitted by the tested equipment. Signal radiated into free space are called **radiated emissions**, whereas signals travelling along power cords or other interconnecting cables are called **conducted emissions**.

Electromagnetic susceptibility (EMS) testing is a way to determine the ability of the device to operate properly in an undesirable electromagnetic environment. These tests use signal sources and power amplifiers to generate high level fields around a device. Conducted susceptibility measurements are performed by coupling an offending signal of a specified level onto cables to try to induce a malfunction into the tested device. Other forms of susceptibility tests include electrostatic discharge (ESD), transient burst and voltage surge testing.

2 EMC REGULATIONS

Regulations are one of the primary reasons we test products for EMC. Therefore, we will now look at some of the important organizations that develop and enforce EMC regulations. Failing to comply with EMC regulations can result in forced removal of a product from the market place or even monetary fines.

Figure 3. Conducted versus radiated Regulations



EMC regulations cover the entire spectrum of electrical products, from computing equipment to microwave ovens to aircraft. As shown, the frequency ranges of interest for EMC testing extend from **30 Hz to 40 GHz** (9 orders of magnitude), depending on the agency and the type of measurement. The frequency range over which regulations exist varies, depending on the device and its intended use.

While individual EMC requirements vary widely from one another, one common aspect is the goal of achieving valid, repeatable results. Therefore, most regulations specify the test environment, receiver and transducer characteristics. Antenna height and polarization is usually varied, and the tested equipment is rotated to find the maximum response from the device. All these actions help insure that the worst-case emissions are found.

Because so many factors affect emissions, an environment with known characteristics must be used when measuring electromagnetic interference. Testing within a known environment is critical in order to assure meaningful and repeatable results that can be compared to other measurements performed on other devices.

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